



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>6</sup> :

H04L 29/06, 12/26

A1

(11) International Publication Number:

WO 97/17790

(43) International Publication Date:

15 May 1997 (15.05.97)

(21) International Application Number: PCT/FI96/00598

(22) International Filing Date: 6 November 1996 (06.11.96)

(30) Priority Data:

955355

7 November 1995 (07.11.95)

FI

(71) Applicant (for all designated States except US): NOKIA  
TELECOMMUNICATIONS OY [FI/FI]; Upseerinkatu 1,  
FIN-02600 Espoo (FI).

(72) Inventor; and

(75) Inventor/Applicant (for US only): RÄSÄNEN, Juha [FI/FI];  
Pensaskertuntie 8 A, FIN-02660 Espoo (FI).(74) Agent: OY KOLSTER AB; Iso Roobertinkatu 23, P.O. Box  
148, FIN-00121 Helsinki (FI).

(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

## Published

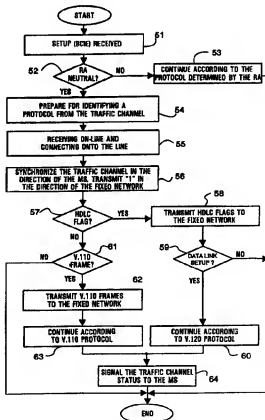
With international search report.

Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: ADAPTING THE FIXED NETWORK PROTOCOLS TO A MOBILE COMMUNICATIONS NETWORK

## (57) Abstract

The invention relates to an interworking function apparatus (IWF), a method and an arrangement for establishing a mobile-terminating call in a mobile communications network when the call is received from a calling party via a fixed network without any signalling support which provides information on the protocol employed by the calling party. In the invention, a service is assigned only one directory number, which is common to all the protocols employed by the service. The protocol identifier in a service definition linked with this directory number has a neutral (undefined) value or may be interpreted as neutral. The IWF, upon receiving the neutral RA parameter (Step 2), is switched onto the line and monitors a traffic channel received from the fixed network in order to identify the protocol employed by the calling terminal equipment (Steps 54-57). After identifying the protocol, the IWF is configured according to the identified protocol (Steps 58-60 or 61-63), and data transfer may begin (Step 64).



**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AM	Armenia	GB	United Kingdom	MW	Malawi
AT	Austria	GE	Georgia	MX	Mexico
AU	Australia	GN	Guinea	NE	Niger
BB	Barbados	GR	Greece	NL	Netherlands
BE	Belgium	HU	Hungary	NO	Norway
BF	Burkina Faso	IE	Ireland	NZ	New Zealand
BG	Bulgaria	IT	Italy	PL	Poland
BJ	Benin	JP	Japan	PT	Portugal
BR	Brazil	KE	Kenya	RO	Romania
BY	Belarus	KG	Kyrgyzstan	RU	Russian Federation
CA	Canada	KP	Democratic People's Republic of Korea	SD	Sudan
CF	Central African Republic	KR	Republic of Korea	SE	Sweden
CG	Congo	KZ	Kazakhstan	SG	Singapore
CH	Switzerland	LI	Liechtenstein	SI	Slovenia
CI	Côte d'Ivoire	LK	Sri Lanka	SK	Slovakia
CM	Cameroon	LR	Liberia	SN	Senegal
CN	China	LT	Lithuania	SZ	Swaziland
CS	Czechoslovakia	LU	Luxembourg	TD	Chad
CZ	Czech Republic	LV	Latvia	TG	Togo
DE	Germany	MC	Monaco	TJ	Tajikistan
DK	Denmark	MD	Republic of Moldova	TT	Trinidad and Tobago
EE	Estonia	MG	Madagascar	UA	Ukraine
ES	Spain	ML	Mali	UG	Uganda
FI	Finland	MN	Mongolia	US	United States of America
FR	France	MR	Mauritania	UZ	Uzbekistan
GA	Gabon			VN	Viet Nam

Adapting the fixed network protocols to a mobile communications network

### **Field of the Invention**

5           The invention relates to a method and an arrangement for establishing a mobile-terminating call in a mobile communications network when the call is received from a calling party via a fixed network without any signalling support for carrying information  
10           on the protocol employed by the calling party.

### **Background of the Invention**

          Present-day mobile communications systems provide the subscribers, in addition to standard speech transmission, with a variety of data transfer features.  
15           The data services usually employ a certain specified communication protocol within the mobile network. In the pan-European digital mobile communication system GSM (Global System for Mobile Communications), for instance, a CCITT V.110 -based, UDI coded rate  
20           adaptation protocol is employed, and, in addition, a radio link protocol (RLP) is employed in non-transparent services. A digital connection from a mobile network to a fixed network, such as an ISDN (Integrated Services Digital Network) or a public  
25           switched telephone network PSTN, may employ different kinds of protocols. Examples of such protocols are the rate adaptation protocols CCITT V.110 and V.120 of the ISDN network.

          An important feature related to data transfer  
30           services are adaptation functions for adapting the internal data connection within the mobile network to the protocols employed by the terminal equipments and other telecommunications networks. Typically, the adaptation functions are a Terminal Adaptation Function  
35           TAF at the interface between a mobile station and a

data terminal connected thereto, and an Interworking Function IWF at the interface between the mobile network and another telecommunications network.

5        Mobile networks are expected to provide a wide range of data services of various kinds which support the commonest data transfer protocols of fixed telecommunications networks. Consequently, a separate IWF is also required for each data transfer protocol. The mobile network must know which data transfer  
10        protocol the terminal equipments wish to employ in each call in order that it would be able to select the correct IWF.

15        In a mobile-originating call (MOC) the mobile station signals the information on the protocol it wishes to be employed towards the fixed network and the called party. In GSM mobile communications system, for instance, the information on the desired protocol is in a Bearer Capability Information Element (BCIE) in a setup message. On the basis of this information, the  
20        IWF is configured to provide a suitable interworking function between the mobile network and the telecommunications network. In case signalling that supports transmitting the protocol information is employed on the entire connection between the mobile  
25        network and the called party, the information is also transmitted to the called party. The required signalling support is provided e.g. in ISDN networks (Integrated Services Digital Network). If such signalling support is not provided, it is the  
30        responsibility of the calling subscriber to select the correct protocol, that is, the calling subscriber must know the protocol of the called subscriber and select the protocol of the IWF accordingly. Signalling support is not available e.g. in the conventional public  
35        switched telephone network PSTN.

A mobile-terminating call (MTC) is more problematic. In case the required signalling support is available on the entire connection between the calling party and the mobile network, the protocol parameters of the calling subscriber are transmitted to the mobile network, which may configure the IWF according to them. In practice, however, signalling support is not always available over the entire connection. This is the case, for instance, when a call originates from the PSTN or has been routed via the PSTN. When the signalling support is not available, the mobile network should be able to obtain the information on the protocol required by the call in some other way.

A prior art approach to the problem is a Multi Numbering Scheme, in which a mobile subscriber has as many directory numbers (MSISDN) as he has different services to which he wishes to receive incoming calls. In accordance with the multinumbring scheme, the calling subscriber dials the directory number of the mobile subscriber according to the desired service. In the GSM system, the services of the subscribers are determined in a subscriber's home location register (HLR), in which other subscriber information is also stored permanently. The HLR is also used for storing information on the mapping between the directory numbers and the services of the subscribers. In the HLR, a specific BCIE element indicating the type of a call and the network resources and the protocol required for the call is also linked with the Mobile Subscriber ISDN Number (MSISDN). The IWF may be configured according to this information. According to the present recommendations, a subscriber has a separate MSISDN number for the V.110 protocol and a separate MSISDN number for the V.120 protocol.

For the network operator and the mobile

subscribers, such a vast number of services causes confusion and trouble. In order for the mobile subscriber to be able to carry out and receive calls requiring different protocols, he must subscribe to several different bearer services from the network operator. From the point of view of the network operator, it is in turn problematic that each user should require a plurality of directory numbers, which wastes the number space of the network. Furthermore, determining the services in the network databases consumes database capacity. The multinumbeing scheme is thus a working, yet a poor solution.

#### **Summary of the Invention**

It is an object of the invention to provide a method and arrangement that allow protocol adaptation between the mobile communications system and the fixed network more efficiently as compared with the present multinumbeing scheme in a case where no signalling support is provided, thus saving the number space and database capacity.

This is achieved with a method for establishing a mobile-terminating data call when the call is received from the calling party via a fixed network without signalling support carrying the information on the protocol employed by the calling party. The method is characterized by

receiving a call to a directory number of a subscriber, said directory number being assigned to a data service employing two or more alternative protocols towards the fixed network,

retrieving from the subscriber data a service definition linked with said directory number, the protocol parameter of said definition having a neutral value or a value that is interpreted as neutral,

assigning an interworking function resource in

accordance with said service definition, omitting the definition of the protocol due to said neutral value or the value that is interpreted as neutral,

5           monitoring by means of the assigned interworking function resource the traffic channel received from the fixed network,

          identifying the protocol employed by the calling party on the basis of signalling characteristic thereof,

10           configuring said assigned interworking function resource to employ said identified protocol towards said calling party.

          The invention also relates to providing an arrangement for establishing a mobile-terminating data call in a mobile communications network when the call is received from the calling party via a fixed network without signalling support carrying the information on the protocol employed by the calling party. The arrangement is characterized by

20           the subscriber database of the mobile communications network having one directory number defined for a subscriber's data service that employs two or more alternative protocols towards the fixed network, the protocol parameter of a service definition linked with said directory number having a neutral value or a value that is interpreted as neutral,

          the mobile network being arranged, in a mobile-terminating call made to said directory number, to assign an interworking function apparatus according to the service definition, but to omit the configuration of the protocol employed towards the fixed network due to the neutral value of said protocol parameter or the value that is interpreted as neutral,

35           said assigned interworking function apparatus (IWF) being arranged to monitor a traffic channel

received from the fixed network, to identify the protocol employed by the calling party (TE) on the basis of signalling characteristic thereof, and to configure itself to employ said identified protocol towards said calling party.

5

It is yet another aspect of the invention to provide an interworking function apparatus for achieving a protocol adaptation between a mobile communications network and a fixed network when a call is received from the calling party via the fixed network without any signalling support carrying the information on the protocol employed by the calling party. The apparatus is characterized by

10

the interworking function apparatus being arranged, in a mobile-terminating call, to assign interworking function resources according to the service definition obtained from the subscriber database, but to omit the configuration of the protocol employed towards the fixed network if the protocol parameter of said service definition has a neutral value or a value that is interpreted as neutral,

15

20

the interworking function apparatus being arranged to monitor a traffic channel received from the fixed network, to identify the protocol employed by the calling party on the basis of signalling characteristic thereof, and to configure said assigned interworking function resources to employ said identified protocol towards said calling party.

25

In the invention, a service is assigned only one directory number which is common to all the protocols employed by the service. In the service definition linked with this directory number, the protocol identifiers are neutral (undefined) in value or interpreted as neutral. When the interworking function (IWF) of the mobile network receives, in case

30

35



of a mobile terminating data call, a protocol identifier which is neutral or interpreted as neutral, it does not attempt, after being switched to the line, to synchronize itself towards the fixed network according to any protocol, but it monitors the traffic channel received from the fixed network in order to identify the protocol employed by the calling terminal equipment. The IWF, however, synchronizes the internal data connection within the mobile network in the specified way in the direction of the mobile station. After identifying the protocol of the calling terminal equipment, the IWF starts to operate in the manner required by the identified protocol. After setting up a data link, the IWF signals the status of the traffic channel to the mobile station in the usual way, and data transmission may begin.

Identifying the protocol is based on detecting synchronization or signalling characteristic thereof. The CCITT V.110 protocol may be identified by means of a V.110 synchronization frame. After identifying the V.110 synchronization frame, the IWF itself starts transmitting V.110 synchronization frames to the fixed network. The CCITT V.120 protocol may also be identified by means of a V.120 frame flag, in addition to which the identification may be confirmed by means of a link setup message. After identifying a V.120 frame flag, the IWF itself starts transmitting frame flags to the fixed network, and after identifying the link setup message, it acknowledges the message etc.

#### **Brief Description of the Drawings**

In the following, the invention will be explained by means of preferred embodiments with reference to the attached drawings, in which

Figure 1 illustrates a mobile communications system in which the present invention may be applied,

Figure 2 is a schematic block diagram of a mobile services switching centre provided with an interworking function apparatus IWF,

5        Figure 3A is a signalling diagram illustrating the first part of call establishment in a mobile-terminating UDI call which is made to an MSISDN number of an asynchronic service of a mobile station from a terminal equipment of a fixed network,

10       Figure 3B is a signalling diagram illustrating the latter part of call establishment shown in Figure 3A, the protocol of the terminal equipment being V.120,

15       Figure 3C is a signalling diagram illustrating the latter part of call establishment shown in Figure 3A, the protocol of the terminal equipment being V.110, and

Figure 4 is a flow chart illustrating monitoring of the traffic channel and identifying the protocol carried out by the IWF.

20       The present invention may be used in all digital mobile communication systems in which data services employ two or more kinds of different protocols towards the fixed network, such as ISDN or PSTN.

25       The present invention is particularly well suited for data transmission applications in the Pan-European digital mobile communication system GSM (Global System for Mobile Communications) and other GSM-based systems, such as DCS1800 (Digital Communication System), and the digital cellular system  
30       PCS (Personal Communication System) in the USA. The invention will be disclosed below by way of example of the GSM mobile communications system. The structure and operation of the GSM system are well known to a person skilled in the art, and they are specified in the ETSI  
35       (European Telecommunications Standards Institute) GSM

specifications. Reference is also made to "GSM System for Mobile Communication" by M. Mouly and M. Pautet, Palaiseau, France, 1992; ISBN 2-9507190-0-7.

The basic structure of the GSM system is illustrated in Figure 1. The GSM structure consists of two parts: a base station system BSS and a network sub-system (NSS). The BSS and the mobile stations MS communicate over radio connections. In the BSS, each cell is served by a base station BTS. A group of base stations is connected to a base station controller BSC, whose purpose is to control the radio frequencies and channels used by the BTS. The BSCs are connected to a mobile services switching center MSC. Specific MSCs are connected to other telecommunication networks, such as the PSTN, and comprise gateway functions for calls to and from these networks. These MSCs are known as gateway MSCs (GMSC).

There are two main classes of databases, associated with call routing. A home location register HLR permanently or semi-permanently stores the subscriber data of all the subscribers of the network, including information on the services the subscriber may have access to, and on the subscriber's current location. The second register type is a visitor location register VLR. The VLR is usually associated with one MSC, but it may, however, serve several MSCs. It is common practice that the VLR is integrated into the MSC. The integrated network element is known as a visitor MSC (VMSC). Whenever the mobile station MS is active (registered and capable of making or receiving calls), the majority of the mobile subscriber information concerning the MS and stored in the HLR is copied to the VLR of the particular MSC in whose service area the MS is located.

Still referring to Figure 1, a data link is

established in the GSM system between a mobile station MS network terminal TAF (Terminal Adaptation Function) 31 and a network adaptor IWF (Interworking Function) 41 in the mobile communication network. In the GSM network, the data link in data transfer is a V.110 rate adapted, V.24 interface compatible, UDI coded digital Full Duplex connection. In this connection, the V.110 connection is a digital transmission channel originally developed for ISDN (Integrated Services Digital Network). The transmission channel adapts to the V.24 interface and also provides a possibility for transfer of V.24 statuses (control signals). The CCITT recommendation for a V.110 rate-adapted connection is specified in the recommendation CCITT Blue Book: V.110. The CCITT recommendation for a V.24 interface is disclosed in the CCITT Blue Book: V.24. In non-transparent data services, a radio link protocol RLP is also employed. The terminal adaptor TAF adapts a data terminal equipment DTE connected to the MS for the V.110 connection, which is established over a physical connection using one or more traffic channels. The IWF couples the GSM V.110 connection to another V.110 or V.120 network such as an ISDN or another GSM network, or to another transit network, such as the public switched telephone network PSTN. The CCITT recommendation for a V.120 rate-adapted connection is specified in the recommendation CCITT White Book: V.120.

As it was explained above, modern mobile communication systems support different kinds of teleservices and bearer services. The bearer services of the GSM system are specified in the specification GSM 02.02 Version 4.2.0, and the teleservices in the specification GSM 0.0.3 Version 4.3.0.

The network adaptor IWF is often placed at the

MSC. Figure 2 illustrates a network adaptor apparatus placed at the MSC, carrying out the adapting to the PSTN and the data services of the ISDN network. For adapting to the PSTN, an ISDN 3.1 kHz audio service or another GSM network, the IWF comprises a group of baseband data modems 41A, which also include a rate adaptor. The modems 41A are autobauding modems capable of handshaking any data rate supported by the GSM system between 300-9600 bit/s, or for HSCSD data services even higher transfer rates, such as 14.4-28.8 kbit/s. Data modem 41A is used e.g. when a data connection is required via an analog PSTN to a data terminal TE of a fixed network or to an ISDN network with a 3.1 kHz audio service. In such a case, there is a similar data modem at the other end of the analog modem connection. There may be any required number of data modems, although Figure 2 only shows one modem 41A for the sake of clarity. The analog side of the modem 41A is connected via an exchange termination ET and the digital side is connected directly to a group switch GSW21 of the MSC. In addition, digital transfer links transmitted via the exchange terminations to the base station systems BSS are coupled to the group switch 21. Furthermore, via the exchange terminations ET, the transmissions channels of other telecommunication networks, such as ISDN or PSTN, are coupled to the group switch 21. The interworking function apparatus IWF of Figure 2 further comprises, for adapting to the Unrestricted Digital Information service UDI of the ISDN network, a data interface unit DIU 41B which comprises a rate adaptor. The DIU is used in GSM data calls to adapt the user data, rate adapted according to the V.110 or V.120 protocol, from the ISDN, as well as the status and control information according to the V.110 or V.120 protocol to the GSM traffic channel, and

in the opposite direction, the user data from the GSM traffic channel as well as the status and control information to the V.110 and V.120 frame structure of the ISDN. The ISDN side of the DIU 41B is connected via the exchange terminal ET, and the GSM side directly to the group switch GSW21. Although only one DIU 41B is shown in Figure 2, there may be any number of them depending on the capacity requirements. The group switch GSW21 and the interworking function apparatus IWF, as well as data call establishing, maintaining and releasing are all controlled by a call control 42. The operation of the IWF is controlled by an IWF control unit 41C which, under control of the call control 42, connects a network adaptor, i.e. the modem 41A or DIU 41B, required by the bearer service used by a particular data call to the data connection. In Figure 2, a solid line illustrates connecting the modem 41A, and a broken line illustrates connecting the DIU 41B. As an example of a mobile services switching center comprising such a network adaptor apparatus, the Nokia Telecommunication Ltd DX200 MSC can be mentioned.

As stated above, a mobile subscriber may traditionally have been entitled to different teleservices and bearer services each having a separate directory number MSISDN. In other words, each subscriber has had several MSISDN numbers. In addition, it has been necessary to determine every teleservice and bearer service of every subscriber in the subscriber's HLR in connection with other subscriber data, and to transfer them to the VLR. In the subscriber data, every MSISDN number is associated with a GSM system BCIE value, either directly or by means of an index pointing to a BCIE values chart. The BCIE is an information element used by the GSM system to transfer information on all the network requirements

related to the call, such as transfer rates, number of data and end bits, etc. The BCIE is described in, for example, the GSM specification 04.08, version 4.5.0, pp. 423-431.

5 In the invention, a service is assigned only one directory number MSISDN, which is common to all the protocols employed by the service. The service definition linked with this MSISDN number is stored in the HLR along with the other subscriber data. In this  
10 service definition, a GSM BCIE is linked with the MSISDN number. In the GSM BCIE the parameter RA (Rate Adaptation) that determines the rate adaptation protocol in the GSM BCIE has a neutral (undefined) value, or a value that may be interpreted as neutral. Presently, the parameter RA may determine the following  
15 cases: no rate adaptation, V.110/X.30 rate adaptation, X.31 flag stuffing, V.120. Furthermore, there are free values one of which may be selected as the neutral value in accordance with the invention. A neutral value  
20 of the parameter RA herein generally refers to a value which does not define any protocol for the IWF, but, as a result of which the MSC/IWF attempts to identify the protocol of a terminal equipment of a fixed network from the traffic channel. The MSC/IWF may also be  
25 arranged to interpret specific values of the RA parameter, such as V.110 and V.120, as neutral.

When the IWF obtains in connection of a terminating data call a neutral value of the RA parameter or a value that may be interpreted as  
30 neutral, it does not attempt to operate according to any protocol after switching to the line, until it has identified, by monitoring the traffic channel from the fixed network, the protocol employed by the calling terminal equipment.

35 In the following, establishing a MT call

according to the invention will be explained with reference to Figures 3A-C and 4. In the example, the service is an asynchronous UDI service, the different protocols employed by the service being V.110 and V.120. It must be noted, however, that the invention is not limited to these protocols, but it generally applies to any protocol.

The signalling diagrams of Figures 3A-C are related to an exemplary case in which a mobile-terminating (MT) UDI call is made from a fixed terminal equipment TE to the MSISDN number of a mobile subscriber, said number being assigned to an asynchronous data service of the subscriber. In such a case, the call is received in the mobile network from an ISDN network, but signalling support is not available on the entire connection between the mobile network and the terminal equipment TE for transmitting the protocol information. The first part of call establishment is illustrated in Figure 3A, and it is similar for both protocols. Figures 3B and 3C illustrate the latter part of call establishment in a case where the terminal equipment TE is employing V.120 protocol and V.110 protocol, respectively.

In Figure 3A, an IAM message (Initial Address Message) is transmitted from an ISDN network to a gateway MSC (GMSC) of the mobile network in a call made to a directory number MSISDN of a mobile subscriber's asynchronous service. The GMSC carries out a routing information request Send Routing Info to the subscriber's HLR, which is determined on the basis of the called MSISDN. Along with the routing information request, the subscriber's MSISDN number is also transmitted. The HLR retrieves from the subscriber data the GSM BCIE linked with the called directory number MSISDN. In this GSM BCIE the parameter ITC (Information



Transfer Capability) has the value UDI and the parameter RA has a neutral value, or a value that may be interpreted as neutral, e.g. V.110. The HLR then transmits the VLR a roaming number request Provide MSRN containing said GSM BCIE. The VLR stores the GSMBCIE and allocates the call a roaming number MSRN. The MSRN is transmitted to the HLR, which forwards it to the GMSC. The GMSC routes the call on the basis of the roaming number MSRN to the MSC in the area of which the mobile subscriber MS is located. The MSC then requests information from the VLR for establishing a mobile-terminating call on the basis of the roaming number MSRN. On the basis of the MSRN, the VLR retrieves the BCIE which was previously received from the HLR, and transmits it to the MSC. Following this, the MSC transmits the MS a call set-up message 'setup', which also contains the GSM BCIE. The MS replies with a 'call confirm' message. Subsequently, the MSC request the BSS with an 'Assignment Request' message to assign the required radio channels, and the BSS acknowledges with an 'Assignment Complete' message. Thereafter, the MSC allocates the required IWF resources by transmitting the IWF an 'IWF Setup' message, which also contains the GSM BCIE obtained from the VLR. At this stage, the operation of the IWF according to the invention begins, illustrated by means of the block diagram in Figure 4.

In step 51 in Figure 4, an IWF control unit 41C (Figure 2) receives from call control 42 of the MSC a SETUP message that contains the BCIE. IWF control unit 41C analyses the BCIE and, upon detecting that the ITC is an UDI, assigns the call a DIU 41B. In addition, the IWF checks the value of the RA parameter (step 52). Provided that the value of the RA parameter is neutral or can be interpreted as neutral, e.g. V.110 or V.120, the IWF control unit does not configure the DIU 41B for

any protocol, but prepares for monitoring a traffic channel received from the fixed network (step 54). Provided that, in step 52, it is detected that the value of the parameter RA is other than neutral or it cannot be interpreted as neutral, the IWF control unit 41C configures the DIU 41B in accordance with the protocol (53) determined by the parameter RA. Again with reference to Figure 3, the IWF acknowledges the allocation of the resources with a message 'acknowledgement'. The MS report with a message 'alerting' that alerting the calling subscriber has been started. The MSC, in turn, transmits the calling terminal equipment TE of the fixed network a message 'address complete' indicating that the connection has been established. The MSC then transmits a message 'connect' indicating that the called subscriber accepts the call, as a result of which the MSC transmits a message 'answer signal' to the calling terminal equipment TE. The MSC then controls the IWF with a message 'device on line'. It is thus returned to the operation of the IWF in accordance with the invention, described in Figure 4.

Again with reference to Figure 4, the IWF control unit 41C (Figure 2) receives from the call control 42 of the MSC a message 'device on line', as a result of which it connects the DIU 41B between the traffic channel received from the GSW21 BSS and the traffic channel received from the PSTN, as shown in Figure 2 with a broken line. Following this, the operation of the IWF continues in accordance with the flow chart in Figure 4.

With reference to Figure 4, after the IWF has been connected onto the line, synchronization of the GSM traffic channel is carried out between the TAF and the IWF in the usual way, and the IWF control unit 41C

starts to monitor the traffic channel received from the fixed network by means of the DIU 41B. The DIU 41B may thereby transmit a string of 1-bits to the traffic channel in the direction of the fixed network because this procedure is the same regardless of whether the calling terminal equipment TE employs a V.110 or V.120 protocol (step 56). Subsequently, the IWF control unit 41C checks whether the signalling received from the terminal equipment TE contains a frame flag typical of V.120 protocol, that is, a HDLC flag 01111110 (step 57). If it does, this is followed by signalling according to Figure 3B.

The IWF transmits HDLC flags to the terminal equipment TE of the fixed network (step 58, Figure 4). As transmitting HDLC flags may be a part of some other protocol than V.120, the IWF control unit 41C checks in the preferred embodiment of the invention whether a data link setup message characteristic of the V.120 protocol is received from the terminal equipment TE (step 59). If the data link setup message is received, the IWF control unit 41C configures the DIU 41B to employ the V.120 protocol, and the IWF begins to operate in the direction of the fixed network in the manner required by the V.120 protocol (step 60). This includes transmitting an acknowledgement to the data link setup message to the terminal equipment TE. Thereafter, the IWF signals a normal traffic channel status to the NS, and data transfer may begin (step 64).

If the data link setup message is not received in step 59, protocol identification is regarded as failed in this embodiment of the invention, and it is proceeded to the end.

Provided that the HDLC flag is not received in step 57 of Figure 4, the IWF control unit 41C checks

whether the signalling received from the fixed network contains a V.110 synchronization frame (step 61). If a V.110 synchronization frame is received, signalling proceeds in the manner described in Figure 3C. In other words, after identifying V.110 protocol by means of the V.110 synchronization frame, the IWF control unit 41C configures the DIU 41B in accordance with the identified V.110 protocol. Thereafter, the IWF transmits V.110 synchronization frames to the terminal equipment TE to the fixed network (step 62, Figure 4). The IWF then continues the operation in accordance with V.110 protocol in the direction of the terminal equipment TE (step 63) and signals the status of the traffic channel to the MS in the usual way by using V.24 statuses (step 64).

In case a V.110 frame is not received in step 61, protocol identification is interpreted as failed in this embodiment and it is proceeded to the end.

The figures and the explanation associated therewith are only intended to illustrate the present invention. In its details, the invention may vary within the scope and the spirit of the attached claims.

25

30

35

## Claims:

1. A method and arrangement for establishing a mobile-terminating call in a mobile communications network when the call is received from a calling party via a fixed network without any signalling support carrying information on the protocol employed by the calling party, c h a r a c t e r i z e d by

receiving a call to a directory number of a subscriber, said directory number being assigned to a data service employing two or more alternative protocols towards the fixed network,

retrieving from the subscriber data a service definition linked with said directory number, the protocol parameter of said definition having a neutral value or a value that is interpreted as neutral,

assigning an interworking function resource in accordance with said service definition, omitting the definition of the protocol due to said neutral value or the value that is interpreted as neutral,

monitoring by means of the assigned interworking function resource the traffic channel received from the fixed network,

identifying the protocol employed by the calling party on the basis of signalling characteristic thereof,

configuring said assigned interworking function resource to employ said identified protocol towards said calling party.

2. A method as claimed in claim 1, c h a r a c t e r i z e d by

identifying the protocol of the calling party as a CCITT V.110 rate adaptation protocol provided that a V.110 synchronization frame is received from the traffic channel,

configuring said assigned interworking function resource to employ V.110 protocol.

3. A method as claimed in claim 1,  
c h a r a c t e r i z e d b y

5 identifying the protocol of the calling party as a CCITT V.120 rate adaptation protocol provided that a V.120 frame flag is received from the traffic channel,

10 configuring said assigned interworking function resource to employ V.120 protocol.

4. A method as claimed in claim 1,  
c h a r a c t e r i z e d b y

receiving from the traffic channel a V.120 frame flag,  
15 transmitting V.120 frame flags to another traffic channel,

identifying the protocol of the calling party as a CCITT V.120 rate adaptation protocol provided that a data link setup message according to V.120 protocol  
20 is received from the traffic channel,

configuring said interworking function resource to employ the V.120 protocol.

5. An arrangement for establishing a mobile-terminating data call in a mobile communications  
25 network when a call is received from a calling party (TE) via a fixed network (PSTN, ISDN) without signalling support that carries the information on the protocol employed by the calling party,  
c h a r a c t e r i z e d b y

30 the subscriber database (HLR) of the mobile communications network having one directory number defined for a subscriber's data service that employs two or more alternative protocols towards the fixed network, the protocol parameter of a service definition  
35 linked with said directory number having a neutral

value or a value that is interpreted as neutral,

the mobile network being arranged, in a mobile-terminating (MS) call to said directory number, to assign an interworking function apparatus (IWF) according to the service definition, but to omit the configuration of the protocol employed in the direction of the fixed network (PSTN, ISDN) due to the neutral value of said protocol parameter or the value that is interpreted as neutral,

said assigned interworking function apparatus (IWF) being arranged to monitor a traffic channel received from the fixed network, to identify the protocol employed by the calling party (TE) on the basis of signalling characteristic thereof, and to configure itself to employ said identified protocol towards said calling party.

6. An arrangement as claimed in claim 5, characterized by the protocol employed by the calling party (TE) being a CCITT V.110 rate adaptation protocol, and said signalling characteristic of the protocol containing a V.110 signalling frame.

7. An arrangement as claimed in claim 5, characterized by the protocol employed by the calling party (TE) being a CCITT V.120 rate adaptation protocol, and said signalling characteristic of the protocol containing a V.120 frame flag or a V.120 data link setup message.

8. An interworking function apparatus of a mobile communication network for achieving a protocol adaptation when a call is received from the calling party via a fixed network without signalling support that carries the information on the protocol employed by the calling party, characterized by

the interworking function apparatus (IWF) being arranged, in a mobile-terminating (MS) call, to

22

assign interworking function resources according to the service definition obtained from the subscriber database, but to omit the configuration of the protocol employed towards the fixed network (PSTN, ISDN) if the  
5 protocol parameter of said service definition has a neutral value or a value that is interpreted as neutral,

the assigned interworking function apparatus (IWF) being arranged to monitor a traffic channel  
10 received from the fixed network, to identify the protocol employed by the calling party (TE) on the basis of signalling characteristic thereof, and to configure said assigned interworking function resources to employ said identified protocol towards said calling  
15 party (TE).

20

25

30

35



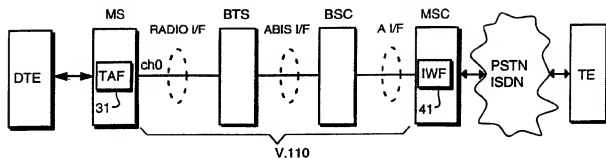


Fig. 1

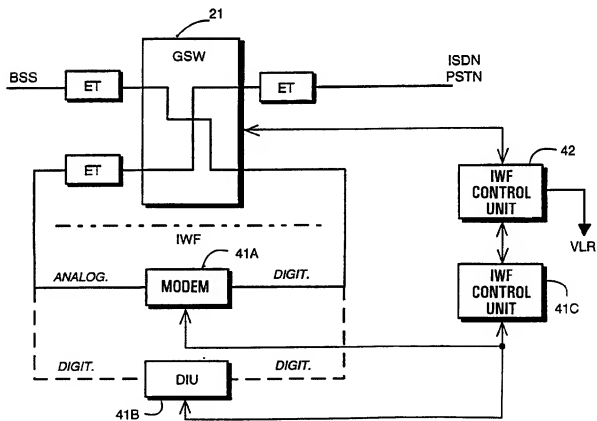


Fig. 2

2/4

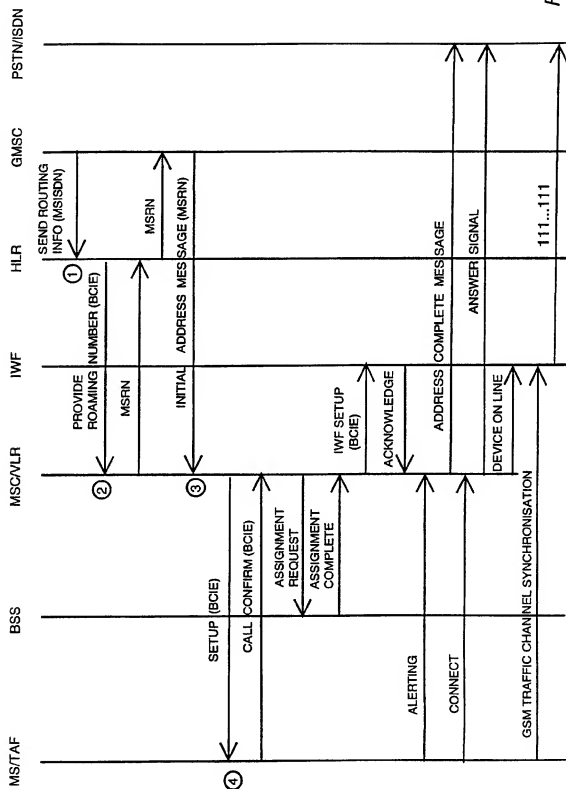


Fig. 3A

3/4

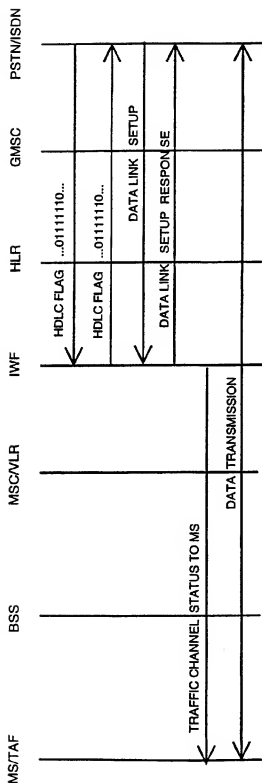


Fig. 3B

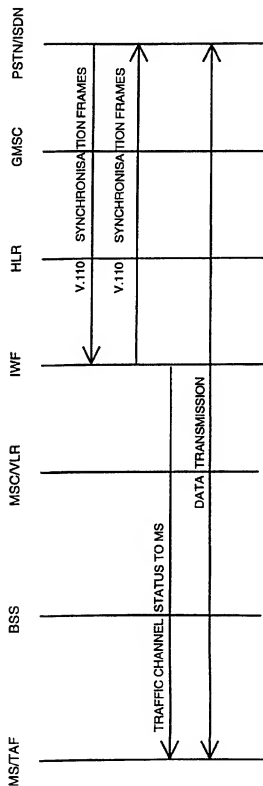


Fig. 3C

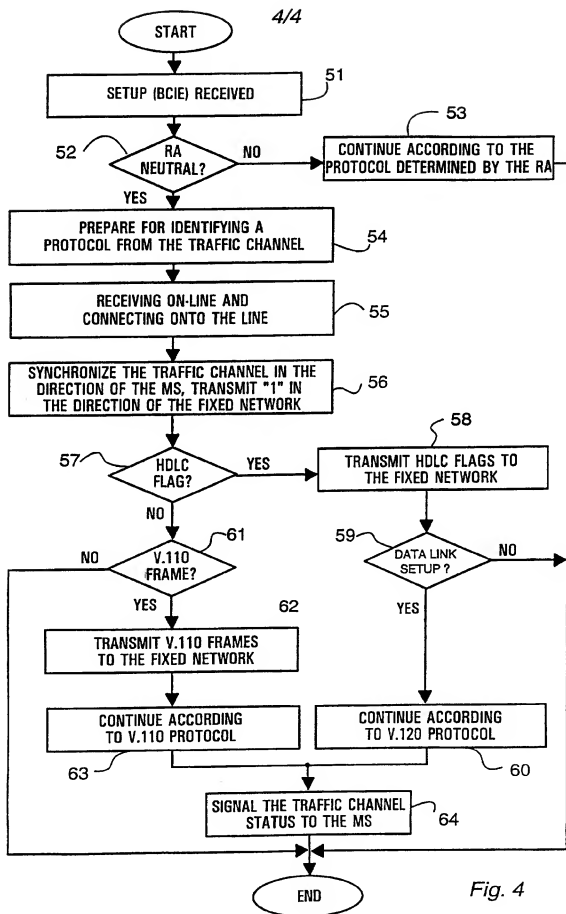


Fig. 4

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 96/00598

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H04L 29/06, H04L 12/26

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H04L, H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0478175 A1 (HEWLETT-PACKARD COMPANY), 1 April 1992 (01.04.92), column 2, line 3 - column 3, line 33 --	1,5,8
A	US 5430709 A (JAMES R. GALLOWAY), 4 July 1995 (04.07.95), see the abstract --	1,5,8
A	US 4891783 A (AKITOSHI ARITAKA ET AL.), 2 January 1990 (02.01.90), see the whole document --	1,5,8
A	EP 0503487 A2 (STANDARD ELEKTRIK LORENZ AKTIENGESellschaft), 16 Sept 1992 (16.09.92), see the whole document --	1,5,8

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

\* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"B" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"Z" document member of the same patent family

Date of the actual completion of the international search

12 March 1997

Date of mailing of the international search report

13 -03- 1997

Name and mailing address of the ISA/  
Swedish Patent Office  
Box 5055, S-102 42 STOCKHOLM  
Facsimile No. +46 8 666 02 86

Authorized officer

Friedrich Kühn  
Telephone No. +46 8 782 25 00

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 96/00598

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>US 5282194 A (THOMAS J. HARLEY ET AL.),  25 January 1994 (25.01.94), column 1,  line 63 - column 2, line 51; column 3,  line 22 - column 5, line 27</p> <p style="text-align: center;">--  -----</p>	1,5,8

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

03/02/97

International application No.

PCT/FI 96/00598

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A1- 0478175	01/04/92	DE-D, T- 69114805	18/04/96
		EP-A- 0474932	18/03/92
		US-A- 5347524	13/09/94
US-A- 5430709	04/07/95	EP-A- 0598739	01/06/94
		JP-T- 6509927	02/11/94
		WO-A- 9326111	23/12/93
US-A- 4891783	02/01/90	JP-A- 62159947	15/07/87
EP-A2- 0503487	16/09/92	SE-T3- 0503487	
		AT-T- 127307	15/09/95
		AU-B- 641586	23/09/93
		AU-A- 1128992	17/09/92
		CA-A- 2062621	12/09/92
		DE-A- 4107742	17/09/92
		DE-D- 59203413	00/00/00
		ES-T- 2080976	16/02/96
		JP-A- 5083248	02/04/93
		US-A- 5311590	10/05/94
US-A- 5282194	25/01/94	NONE	